## EARTH-MOVEMENTS IN THE BAY OF NAPLES.[1]

IN spite of the prolonged discussions on the question of changes in the relative level of land and sea in connection with the Temple of Serapis [2] at Pozzuoli, yet much remained unknown with respect to the movements of the Italian coast which it was surmised must have taken place since Roman times. An exclusive study of the columns of this building is insufficient to indicate the Roman sea-level relative to the land, for although the lowest portion of the columns, now below sea-level, was obviously above it, we cannot determine to what extent. Neither can we conjecture the size of the area affected by the movements; indeed, by the undue prominence which has been almost universally accorded to the Serapis phenomena in geological treatises, many authorities, among whom was Prof. Suess, were led to the conclusion that the phenomena were strictly local and almost confined to the Bays of Baia and Pozzuoli, in short, to the country immediately surrounding Monte Nuovo.

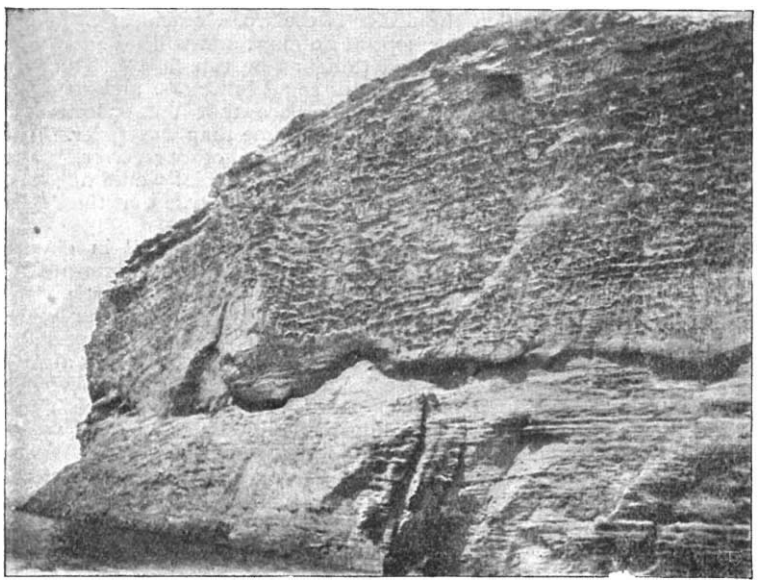

FIG. 1.—The Upper Groove of Erosion on Tufa Cliffs of Nisida.

*Note the difference of the texture of the surface below the upper erosion line, which has been preserved by submergence, and that above, which has been weathered.*

It was with the object of collecting facts for the elucidation of these points, that we undertook the work of surveying and describing the little-known remains of Roman constructions which are so numerous around the Bay of Naples. Some of them are still standing on the present water-line, while some are awash and some deep beneath the surface: and from localities furthest from Monte Nuovo, we obtained evidence of earth-movements not less great than from localities nearer the mountain; thereby confirming our conjecture, as to the movement of the land spreading over a more considerable area than had been supposed at first.

At many points on the coast (Fig. 1), and especially in the limestone cliffs of Capri, the observer may note a clearly marked line of grooves and holes at a height varying from 23 feet to 12 feet above the present sea-level. This line, which presents the same appearance as one which traverses the rock face along the present water-line, is undoubtedly due to the same cause, namely, the eroding action of the surface of the sea. The upper marks of erosion correspond in height with the highest Lithodomus borings in the columns of the Temple of Serapis, thus showing that the entire Bay of Naples took part in the movement of the subsidence and subsequent elevation of the temple, and, as evidence of the same sort is to be found forty miles north at Gæta, and probably on the promontory of Mt. Circello as well, if atmospheric weathering has not obliterated the traces of marine erosion, the same alteration of land-level must have affected a large extent of the Mediterranean sea-board.

The changes of level have been deemed by some to be due to periodic changes in the level of the ocean. We are unable to accept this view, for we should expect the oscillations of the water-level to be of a regular and tide-like nature, as Niccolini, the eminent exponent of the theory, must himself have imagined, for the curve illustrative of his theory of marine phases is essentially a tidal curve, but the marks of erosion indicate spasmodic movements, changes of level during relatively short periods alternating with prolonged periods of rest. Another point against the theory of the change of sea-level is that the line of erosion, though continuous, varies in height; for instance, at the east end of Capri it is 10 feet higher than at the west, and smaller variations have been noted elsewhere. These facts are more reasonably accounted for by a theory of change of land-level, rendering inequalities in the oscillatory movement natural, than by a theory involving changes in the level of the sea.

Interesting as it is to search for the traces of her handiwork that nature leaves in her own domain of rocks and cliffs, yet we confess to an interest not less keen in seeking out those she has left on the handiwork of man, on the remains of the Roman buildings by the sea. Massive piles of masonry and concrete, once part of some noble building, have been roughened by the never ceasing onslaught of the waves to the semblance of the brown rocks upon which they stand; and it is only possible to distinguish between the natural and the artificial on calm days, when they can be seen through the clear water.

It is the accumulated evidence furnished by these water-worn ruins that gives so strong a confirmation of our theory that, notwithstanding the oscillatory land-movement indicated by the upper erosion line before mentioned, the present land-level is far below the Roman land-level—how far we cannot exactly say, but we believe that the approximate figure of 17 feet will not be found to be very wide of the mark.

[1] The author's papers here summarised are:—"On the Possibility of Obtaining more Reliable Measurements of the Changes of the Land-level of the Phlegræan Fields (*Scottish Geographical Magazine*, October, 1900). "Earth-movements in the Bay of Naples" (*Geographical Journal*, August and September, 1903). "The Submerged Greek and Roman Foreshore near Naples" (*Archæologia*, vol. lviii. pp. 1–62, figs. 1–29, plates xlv.–li., 1903). A few copies of the two last papers, reprinted with corrections, have been issued under the title "Contributions to the Study of Earth Movements."

[2] *Macellum*, or market-place, would be a more correct name for the building than "Temple of Serapis."

The evidence is of the most diverse description; masses of concrete or of Roman brickwork may be seen under water, so disposed that they show the ground-plans of the buildings they once supported; stairways with steps several feet below water are cut in the rock of caves, the walls of which still show traces of a stucco covering even where they are submerged; a drain which runs several feet below the surface, in a sea-side palace of Tiberius; artificial tunnels or *cuniculi* entirely submerged; these are but few among many other facts which have been a puzzle to antiquarians, and can be accounted for by the theory that the Roman land-level was about 17 feet higher than the present.

By the same theory we can explain why the malarious Lago d'Agnano was not mentioned by Roman writers, for it would not have been in existence with the land at the higher level; the present unhealthiness of the low-lying plain of Pæstum, once the site of a flourishing Greek colony, is also explained; then the Pool of Baiæ, mentioned by classical writers, and an island off Dicæarchia, described by Pausanias (Fig. 2), that have apparently vanished, we find by this theory to have been carried down by the land as it sank so that they are now covered by the sea; and finally the Roman fresco representing the famous breakwater of Puteoli Harbour (Fig. 2), which shows us the arches that join the piers or *pilae*, with the springing of the arches well above the water, is of the breakwater as the Romans saw it; nowadays the springing of the arches is submerged (Fig. 3).


*Pausanias Island.*

FIG. 2.—The Breakwater of Puteoli, after a Roman Picture.

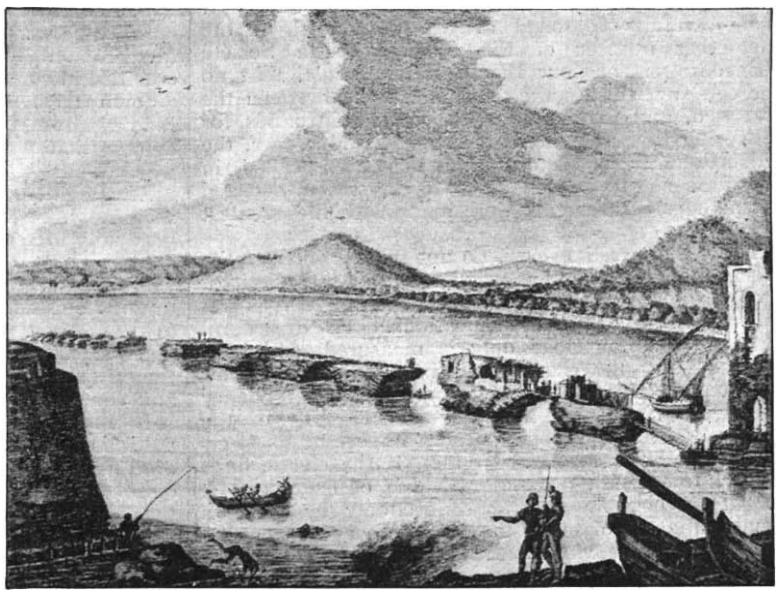

FIG. 3.—The Breakwater of Puteoli, after an eighteenth century drawing.

These researches have thrown a new light on a point of controversy among scholars, namely, the question as to the exact site of the ancient Greek colony of Palæpolis, the mother-town of Neapolis, the present Naples. This ancient town was supposed by some authorities to have stood where Naples now is, by others to have been further inland towards Aversa. Following up our hypothesis that the shore was higher by nearly 17 feet than it is now, there would be a stretch of land extending nearly half a mile out to sea at the base of the cliffs of the promontory of Posilipo; it is here, where the ruins now under water attest to the existence of numerous buildings grouped round the Gaiola rocks, that we would place Palæpolis. Close by under the lee of this extended foreshore we discovered the defensive works of an ancient harbour, and we found many traces of an ancient coast road, also submerged, which ran along the foot of the cliffs and by tunnels through some of the little headlands on the eastern side of Posilipo (Fig. 4). This road gave an easy means of communication with the neighbouring colonies, and the many proofs we have found of its existence, as well as the geographical situation of the southern extremity of Posilipo, which was pre-eminently adapted to the conditions of Greek colony life, have emboldened us to believe that here, beneath the foundations of the later Roman edifices, the site of the vanished town is to be sought.

FIG. 4.—Ancient tunnel through Headland of the Villa Luisa, Posilipo. (After an oil painting by Mrs. Holcombe Ingleby.)

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